CHARACTERISTIC DIFFERENCES BETWEEN RECALL AND RECOGNITION

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The more obvious practical importance of *recall* in daily life seems to have led the greater part of experimental work on memory in this direction, to the comparative neglect of the not less interesting process of *recognition*. The recent work of Müller, Strong and others has called attention to certain instructive and hitherto unreported differences between the two processes. Thus Müller reports that retroactive inhibition fails to appear if partially learned material, followed by some different task, is merely recognised. But in the case of reproductive memory the addition of the incidental task is found to bring about a considerable reduction of recall efficiency. Strong finds that whereas, in recall memory " with increase in the length of the series there is much greater corresponding increase in the time or energy required for its mastery," in recognition memory the results indicate " that the number of stimuli in the series affects the results almost in direct proportion to the increase." Kirkpatrick finds that, under given circumstances, about twice as much can be recognised as can be recalled.

It is probable that a more careful study of the phenomena and laws of recognition will throw light on various other processes concerning which there is still much to be learned. Feelings of identity and of familiarity are fundamental in many intellectual operations, so fundamental indeed that one is tempted to classify them as ultimate experiences which cannot be further analysed. Since this short paper is intended to be suggestive rather than final, no attempt will be made to summarize previous work on recognition. The results to be reported were secured, for the most part, in experiments performed for other primary purposes. They are thus, in most cases, incidental results, but are perhaps for that very reason even more suggestive than if they had been deliberately secured from the point of view in which they are now considered.

Schematically, at any rate, the difference between recall

and recognition seems to be a rather simple matter. Recall is that aspect of memory process in which a *setting,* a background or association-cluster, is present in clear consciousness, but a desired *focal element* is missing. Thus I try to recall the name of Byron's hero in "The Prisoner of Chillon." The memory of the theme, the aspect of the castle, the pillar in the dungeon, the beauty of the lake and mountains, constitute a clear setting, but the focal element, the name, is missing. When it appears it probably comes in fragments,—first the form or rhythm of the word, then various letters or syllables, one fragment dragging in the others and being assisted in this by various features of the general setting. The following series, resulting from an actual attempt to recall this name, shows the way in which the unitary focal element is finally constituted by its various fragments:

> *B*alboa
> *B*omb*ardo*
> *Lom*b*ro*so
> *B*azza*dof*
> *B*ar*b*ad*o*es
> *Lom*bardo
> *B*on*av*entu*ra*
> *B*on*av*ent
> *B*oni*var*
> *B*oli*var*
> *B*oni*vard* (correct)

Recognition is, schematically, just the reverse of this process. In recognition the focal element is present, in the form of sensation, image, or feeling, and the question is whether or not this element will recall a more or less definite general setting or background. Such experiences as those indicated by, "Where have I seen that face before?" "Have I ever heard this sermon?" "Whose voice is that?" etc., illustrate this situation. It is indeed often true that the setting need not come into clear consciousness in order to determine the outcome of judgment or the feeling of recognition. At least it need not become as clear as the recalled element in reproductive memory, in order to produce the feeling of familiarity. But the mere feeling of familiarity represents only a partially complete recognition. The completeness of the recognition will depend on the clearness or briskness with which the setting or certain features of the setting happen to be revived. James has vividly described

the way in which vague marginally revived processes may reveal their presence, character and behavior by the production of a resultant feeling (familiarity, recognition, novelty, intention, etc.).

It is often said that recognition is an important part of recall memory, giving warrant to the correctness of the recalled element. This may often be the case, but it is not necessarily so. Items may be correctly recalled but not recognised as correct and rejected. Moreover every case of recognition presumably involves recall or tendency to recall on the part of the setting. The ordinary act of " memory " is said to be complete when focal element and setting belong together, that is, mutually recall or sustain each other.

If this schematic distinction between setting-element and element-setting is a correct one, it at once becomes interesting to picture some sort of neural counterpart of the two processes; to conceive in neural terms the differences in the behavior of the two aspects of memory. Why, for example, does retroactive inhibition affect the one process and not the other? Why does increase in series length influence the two processes in different degrees? Why is more material recognizable than can be recalled? Nor are these the only questions to be raised, for there are many other empirical differences between recall and recognition. Some of these further differences it seems worth while pointing out, even though the data on which the comparisons are based are so incomplete as to be suggestive only of qualitative rather than of quantitative differences.

1—Determination to Remember

As is well known, mere repetition, without the purpose or intention to retain, does not by any means guarantee the subsequent ability to recall. In fact the determination to learn is one of the most important conditions of reproductive memory. Rather curiously the influence of purpose or intention in the case of recognition seems to be much less than in the case of recall. The results of the following experiment suggest the striking difference between the two cases.

In an experiment performed primarily for another purpose than the study of memory, each of five observers went through a form of the " opposites " test from 60 to 75 times. The stimulus card bore 50 adjectives and the task was to speak the opposite of each word in turn, as quickly as possible. One or two trials were made each day, the same

list being used but the words occurring each time in a new and random order.

After 60 to 75 trials had been made, each observer was asked to recall and write down all the pairs of opposites that had been used. Fifteen minutes were allowed for this test, but the number recalled after the first three minutes was also noted.

After this test a list of 100 pairs of opposites, containing 50 new pairs along with the original 50, was presented. Each observer was now requested to identify the 50 pairs used in the experiment. In this case all observers completed their selection in three minutes or less.

The following Table gives the number of correct recollections and recognitions for each observer, and the averages of the five observers. Only slightly more than half (28.8) of the 50 items were recalled in a quarter of an hour, about half of these being reproduced in the first three minutes. In the case of the recognition test, however, practically every item is correctly identified within three minutes or less.

TABLE 1

INFLUENCE OF INTENTION ON RECALL AND RECOGNITION

	From a total of 50 original items		
Observer	Number recalled		Number recognized in 3 min. or less
	In 3 min.	In 15 min.	
L	19	38	50
G	14	27	49
H	10	27	49
R	12	25	50
P	19	27	50
Averages	14.8	28.8	49.6

Here we have a case of purely incidental memory, there having been no determination whatever to memorize the list of stimulus words. As a result, no doubt, of this absence of intention, the 60 to 75 repetitions failed to make sufficient impression to make possible more than 30 per cent recall efficiency. But in spite of the absence of intention to remember there is practically 100 per cent recognition efficiency, and the indications are that this efficiency would have been found

long before the last repetition. It is not possible, on the basis
of these figures, to say that recognition is not influenced by
the presence or absence of the determination to remember,
but it is clear that it is much less influenced by this factor
than is the process of recall.

2.—Value of Repetitions

The above result suggests that a given number of repeti-
tions of the material has greater value for recognition than
for recall. It is, of course, a matter of common experience
that a single presentation may suffice to enable recognition
but be quite insufficient to make recall possible. It would
be of interest to determine more or less precisely the
equivalence of repetitions in the two cases, for different
materials and observers. The following results are sugges-
tive of the sort of differences revealed by experiments
designed for this purpose.*

Fifteen items were presented visually, at intervals of two
seconds, to each of five observers. Each observer, immedi-
ately after the completion of the series, was requested first, to
recall and reproduce or describe as many as possible of
the fifteen items, and then to select, from a set of thirty
items, the fifteen just presented. This method thus gives an
approximate measure of the tendency to perfect recall on the
one hand and the tendency to perfect recognition on the
other hand, resulting from the single presentation. The series
was then presented a second time and the recall and recog-
nition test repeated. This process was continued until both
perfect recall and perfect recognition were achieved, and the
number of repetitions required in the two cases was thus
determined. Four different sorts of material were used,—
nonsense syllables, simple geometrical forms, pictures, and
words (nouns and adjectives). Table 2 gives, for each
observer and for each sort of material, the number of repeti-
tions required for perfect recall and for perfect recognition,
and the ratio of recall to recognition.

The results are rather interesting. When the material
is quite devoid of sense or meaning, as in nonsense syllables,
there is very little difference between the number of repeti-
tions required for complete recall and the number necessary
for complete recognition. As we pass from nonsense
syllables through geometrical forms and simple pictures to
common nouns and adjectives, the sense or meaning of the
material becomes more and more definite and the possibilities

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* These experiments were performed by Miss Edith Mulhall,
Barnard, '13.

of associative setting increasingly richer. As this happens we find a correspondingly greater difference in the effect of repetitions for recall and recognition. The recall-recognition ratios increase from 1.2 through 1.4 and 1.9 to 2.2 respectively. This change in the ratios is furthermore due entirely, in these instances, to the increasing ease of recognition in the case of meaningful material. The average number of repetitions required for complete immediate recall changes very little. In general then, with meaningless material repetitions are equally effective for recall and for recognition. But with increase in the meaningful character of the material this influence becomes relatively greater in the case of recognition, until, with nouns and adjectives, it is more than doubled.

TABLE 2

EQUIVALENCE OF REPETITIONS FOR RECALL AND RECOGNITION

Material	Process	Repetitions for different Observers					Averages	Ratio of Recall to Recognition
Words....	Recall.........	3	3	5	3	6	4.0	2.2
	Recognition....	1	1	2	2	3	1.8	
Pictures..	Recall.........	3	3	3	2	4	3.0	1.9
	Recognition....	2	1	2	1	2	1.6	
Forms....	Recall.........	4	3	4	4	3	3.6	1.4
	Recognition....	3	2	3	2	3	2.6	
Syllables..	Recall.........	5	5	7	6	5	5.6	1.2
	Recognition....	3	3	6	6	5	4.6	

3.—Degree of Assurance

Watt remarks, " unfortunately, however, no very reliable test of recognition is known. . A learner can either recall a word or he cannot. . . . But he may say he recognises a word without either being sure that he does so, or without really recognising it at all." And, " Correct and sure recall ought to bring with it the assurance of its correctness."

But does not recognition also bring with it the degree of assurance of its correctness? All that is necessary for a reliable test of recognition is a situation in which the chances of accidental correctness are known. This situation being given, it is no difficult matter to test the accuracy of recognition for various individuals, materials, and conditions.

TABLE 3

Correctness and Assurance in the Recognition of Different Materials

| SYLLABLES | | | | | GEOMETRICAL FORMS | | | |
Obs.	A	B	C	D	Obs.	A	B	C	D
1	72	65	72	60	1	97	72	50	60
2	78	50	75	..	2	85	..	..	..
3	72	63	65	44	3	84	65	55	33
4	81	52	44	..	4	95	70	..	..
5	76	51	67	..	5	90	50	50	..
6	89	63	50	50	6	90	75	75	..
7	67	63	56	..	7	90	75	67	..
8	63	27	33	..	8	64	55	75	(100)
9	89	76	63	55	9	82	67	58	(100)
10	75	50	..	50	10	87	50	..	..

| WORDS | | | | | PICTURES | | | |
Obs.	A	B	C	D	Obs.	A	B	C	D
1	90	100	72	50	1	100	84	67	72
2	68	53	25	..	2	89	..	..	..
3	71	60	83	50	3	89	81	77	..
4	91	60	..	..	4	95	80	33	..
5	92	..	..	..	5	98	..	..	..
6	95	57	33	..	6	96	63	50	..
7	87	50	71	42	7	100	..	..	..
8	89	60	60	50	8	96	75	..	..
9	90	80	30	..	9	93	100	..	..
10	80	85	66	..	10	93	100	..	..

Averages of the 10 Observers

Material	A	B	C	D
Syllables....................	76.2	56.0	58.0	52.0
Forms.......................	86.4	64.0	61.0	50.0
Words.......................	85.3	67.0	55.0	48.0
Pictures......	93.0	83.0	57.0	....
Grand Averages.........	85.2	67.5	57.8	50.0

A test of the accuracy of recall requires only simple enumeration of correct reproductions and their proper relative evaluation. A test of the fidelity of recognition requires more elaborate statistical treatment of the data, perhaps, but the two methods are not unequally reliable. Just what degrees

of assurance recognition does bring, and just how correctness varies with this confidence, has been but little investigated.

The figures on page 538 resulted from experiments on this point. Syllables, geometrical forms, advertisements (picture and reading matter), and words were used, and the attempt made to measure the curve of forgetting for recognition, by testing at various intervals after the original presentation. This method was soon seen to be inadequate for the primary purpose of the experiment, since at each test the original material was again seen (though along with other material, to be sure) and the various items chosen at a given trial reinforced by the mere fact of their having been thus selected. But from the point of view of assurance and correctness the experiment afforded ample material at each trial. Ten observers were used, and the degree of assurance indicated in the case of each selection by grading the confidence of the identification as A, B, C or D. The Table gives typical results, showing the total correctness of each degree of certainty for intervals covering a period of twenty-one days.

Several suggestions are afforded by the Table.

a.—The correctness for C and D degrees of assurance (slightly .certain and mere guess) is about the same for all four kinds of material. The mere guesses show just the chance relationship (50%, since the items were selected from a larger group containing twice the original number), and the C judgments some 8% higher correctness.

b.—The A and B judgments have higher and higher validity as one passes from nonsense syllables through forms and words to more complicated and meaningful material (advertisements). With syllables, A and B judgments are about 66% correct, with forms and words about 75%, and with advertisements about 88%.

c.—In these latter cases the C and D judgments are less used than is the case with less meaningful material. The four kinds of material show a regular progression in the number of observers not using the C and D degrees of confidence. The A and B judgments are thus more often correct in spite of the fact that more of the items are reported with these high degrees of assurance.

Strong has studied recognition for advertisements and for words, and finds varying percentages of correctness for different degrees of confidence as the length of series is increased. The same investigator has also considered some of the statistical difficulties involved in the correct evaluation and scoring of.data secured by the method of selection.

4.—*Influence of Primacy and Recency*

That primacy and recency of impression influence the accuracy of recognition in much the same way that they influence recall, is seen from the following experiment. Fifteen pages, each containing an illustration along with reading matter, were arranged serially on a table. Twenty observers were allowed to begin at one end of the series and inspect all the items, from left to right, for a short period of time. These fifteen items were later presented along with an equal number of new items, and each observer attempted to identify the original set. The following Table gives the per cent of times that the items in the fifteen different positions were identified.

TABLE 4

INFLUENCE OF PRIMACY AND RECENCY ON RECOGNITION

Position	Per cent. of times identified	Averages of groups of 5 positions
1	84	
2	36	
3	44	
4	36	
5	20	44
6	12	
7	16	
8	4	
9	8	
10	20	12
11	4	
12	20	
13	28	
14	16	
15	56	25

Quite as in the case of the reproduction of simple material after serial presentation, we find primacy and recency both effective, and the former, under the conditions just described, considerably more influential than the latter.

5.—*Recognition Span*

The fact that there is a more or less definite reproductive "memory span," which varies with the individual, with the material, and with other conditions, is familiar. Aside from

this elementary span, with perfect reproduction, only a limited number, from a larger number of presented items, can be reproduced, and this number varies not only with individual and with material, but also with such factors as series length, time interval, etc.   Much the same thing holds for recognition, although but little evidence for it has been presented.   Strong finds that, "When five advertisements are successively exposed 86% can be recognised immediately after, while only 47% can be recognised from 150 advertisements similarly exposed.   The per cent of correct recognitions decreases as the length of the series increases," and "This decrease is possibly faster at first and then steadily becomes less as the series are increased in length."   The following results also bear on this question of immediate "recognition span."

<div align="center">TABLE 5</div>

Per cent. of 15 advertisements immediately recognized, average. of 25 observers	.78
Per cent of 25 normal advertisements, average of 20 observers	.76
Per cent. of 25 geometrical forms, average of 20 observers	.62
Per cent. of advertisements when original copy is retained but the cut is changed	.56
Per cent of advertisements when original cut is retained but the copy changed	.43
Per cent. of times substitution of a new cut is detected	.26
Per cent. of times substitution of new copy is detected	.17

The fidelity of recognition clearly varies with the type of material.   It also depends on the integrity of the original items, and this fact seems to indicate that the recognition is not entirely of the item as a whole, but is conditioned by specific details in the total composition.   Experimental variation should show in any given case just which details are most important.

6.—Recognition after Longer Intervals

Similar differences in fidelity of recognition for different sorts of material are found when a longer time intervenes between the original presentation and the occasion of identification.   The following results are from an experiment on the curve of forgetting for recognition, and show also the decrease in per cent fidelity which results when the number of items in the original series is increased.

The nonsense syllables show a considerable loss, both from increase in series length and from increase in interval.   Words show a smaller loss, although loss is present from both

TABLE 6

PER CENT. ·OF CORRECT RECOGNITIONS, WHEN CHANCES OF
ACCIDENTAL CORRECTNESS ARE AS 1 :1. AVERAGE
OF 10 OBSERVERS

After 2 days

	Advertisements	Forms	Words	Syllables
Series of 15 items....	93	85	78	75
Series of 25 items....	94	75	74	60

After 14 days

Series of 15 items....	80	81	77	66
Series of 25 items....	80	80	72	56

causes. Forms show no loss due to increased interval, and only after the shorter interval (two days) is there loss due to increased series length. Advertisements, on the other hand, show no loss whatever as a result of increase in series length, but lose appreciably with increased interval.

7.—Individual Differences

Individual differences in fidelity of recognition are apparent in any experiment with this process. The range of these differences may be roughly indicated by the ratio of best to poorest in any given group of observers. Using college students, the range is usually about as follows.

TABLE 7

RANGE OF INDIVIDUAL DIFFERENCES IN FIDELITY OF RECOGNITION

Advertisements, 1st set................................	2 .1 to 1
Words...	2 .1 to 1
Mutilated advertisements..............................	2 .1 to 1
Geometrical forms...................................	1 .9 to 1
Advertisements, 2nd set..............................	1 .8 to 1
Syllables..	1 .5 to 1
Forms, 2nd set......................................	1 .4 to 1
Simple pictures......................................	1 .1 to 1
Average......................................	1 .8 to 1

The ratio of about 2 : 1, which is found in these cases, is found in so many experiments on various sorts of mental capacity that it cannot be entirely without significance. Professor Cattell calls attention to numerous cases in which this ratio of best to poorest is present. It should not of course be taken to indicate any necessary distribution of capacity among

human beings in general, for the range here is much greater than that represented by this ratio. What it does seem to indicate is that, when individual observers are chosen from a social group which is formed on the basis of some more practical consideration,—as college students, engineers, 8th grade children, etc., a range larger than this will not usually be found. This seems to mean that a ratio of two to one, as between best and poorest, includes those individuals who can satisfactorily and practically find a permanent place in the given group. A more extreme variation, either above the best or below the poorest, is sufficient to place the individual in another social group, and he is not likely to be included among our observers unless special care is taken to find him.

SUMMARY

1. A closer study of recognition than has been made heretofore will probably contribute much to our knowledge of other processes as well.

2. A schematic account of the mechanisms of recall and of recognition seems to involve a common neural pattern, operating in reverse " directions " in the two cases.

3. Purpose, intention, and similar determining tendencies, are much more effective in recall than in recognition.

4. The value of a single presentation is greater in recognition than in recall, and the difference between the values of repetitions becomes still greater the more meaning the material possesses.

5. Recognition is based on varying degrees of assurance, and the degree of this assurance is a fairly definite index of the accuracy of the recognition. Assurance varies with the individual, the material, the length of series, the integrity of the items, the time intervening since original presentation, etc.

6. Assurance and correctness are higher the farther the content is removed, in character, from nonsense material.

7. Primacy and recency influence recognition much as they do recall, and, under certain conditions at any rate, primacy is stronger than recency.

8. A definite " recognition span " may be found, which will vary with numerous individual, material and technical conditions.

9. When the attempted identification is not immediate but takes place at longer intervals after original presentation, various sorts of materials show characteristic differences in relative recognisability and in effect of increased interval.

10. The influence of increased series length varies with the material, and stands, in general, in inverse relation to the meaningful character of the material.

11. The range of individual differences in fidelity of recognition within a given socially selected group is similar to that found in the case of other individual differences.

12. The indications are that a range of about 2:1, as between best and poorest, includes the limits of variation which common experience imposes on the selection of a practical or social group.

13. Other interesting facts concerning recognition have been suggested, such as the failure of retroactive inhibition, relatively small influence of increase in series length, etc.